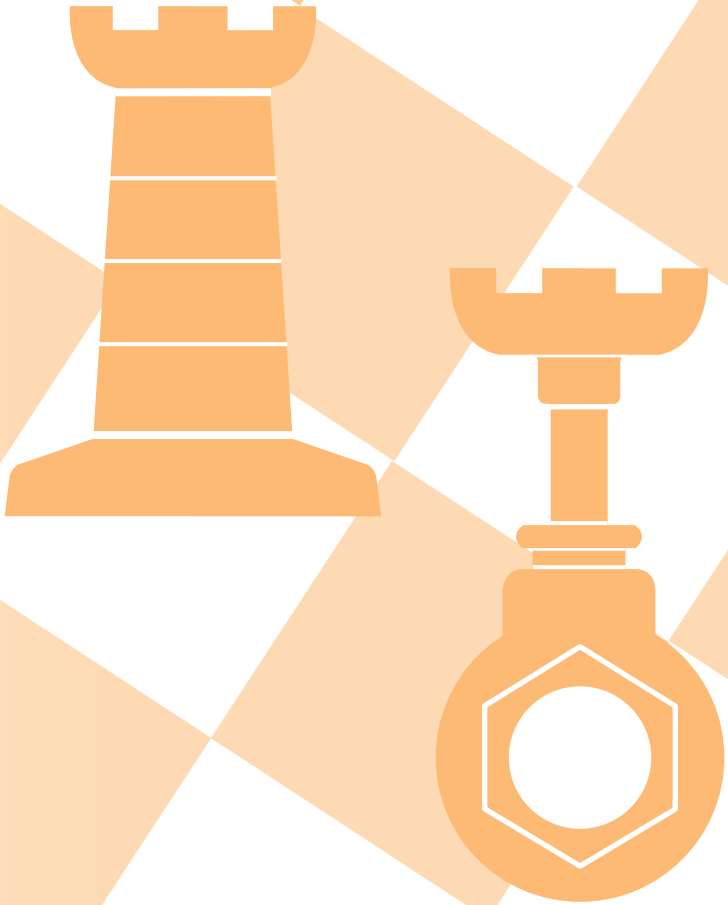
GENERAL INFORMATION LEAFLET 59

Central Heating System Specifications (CHeSS)

Year 2002



Basic and best practice specifications for the components of domestic wet central heating systems that are critical to energy efficiency

2002 EDITION

BEST PRACTICE PROGRAMME

HOUSING ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

GENERAL INFORMATION LEAFLET 59

INTRODUCTION

CHeSS (Year 2002) replaces CHeSS (Year 2000) to take account of changes to Building Regulations and other developments.

This leaflet gives basic and best practice specifications for the components of domestic wet central heating systems that are critical to energy efficiency. '**Basic**' means sufficient to comply with Building Regulations Part L1[1] and Building Standards (Scotland) Regulations Part J[2] that came into effect in April 2002 and March 2002 respectively. Part L1 now applies to replacement heating systems in existing housing, as well as new ones. '**Best practice**' means the adoption of products and techniques that are already established in the market, cost effective, and able to save energy without incurring undue risks: this evolves with emerging technological development.

The leaflet also includes reference tables to show typical SAP ratings, carbon indices, energy savings and fuel cost savings attributable to CHeSS. These were formerly in a separate publication.

The specifications have been prepared for the Housing Energy Efficiency Best Practice programme at the request of the Heating Strategy Group of the Energy Efficiency Partnership for Homes, with assistance from the trade associations of manufacturers of heating products.

More detailed advice on the selection and installation of domestic wet central heating systems is given in Good Practice Guides (see Refs[3], [4]), and also Ref[5].

- Purchasers should use the CHeSS specifications to ensure their heating installations will conform to current basic or best practice
- Installers should use them to quote for systems of defined quality, comparable with their competitors
- Following the specifications will improve energy efficiency and reduce carbon emissions, and quantified savings are included for reference.

REFERENCE TABLES

REFERENCE TABLES SHOWING SAP RATINGS, CARBON INDEX, ENERGY CONSUMPTION, AND SAVINGS ATTRIBUTABLE TO CHESS

Tables 1 to 3 on pages 9 to 11 show the benefits of domestic wet central heating systems that meet the CHeSS specifications. For different fuels (gas, LPG, oil) and a range of dwelling types the tables give quantified improvements to the SAP rating and Carbon Index, energy consumption, and fuel costs. Where savings are quoted, they are compared with a reference case, explained below. The 'basic' and 'best practice' calculations are based on boilers that meet the minimum efficiencies specified in CHeSS, but higher savings are possible by purchasing boilers with SEDBUK above those minimum levels (boilers can be obtained with efficiencies up to 91% for gas or 95% for oil). Other columns in the Tables are explained below.

SAP (The Government's Standard Assessment Procedure for Energy Rating of Dwellings, 2001 edition, DEFRA)

SAP is the UK Government's procedure for calculating home energy ratings (see Ref[6]). It is a reliable way of calculating the energy efficiency performance of dwellings. The SAP index is based on the calculated cost for space and water heating, adjusted for floor area so that it is not strongly affected by the size of the dwelling. The index is a number from 1 to 120, where higher numbers indicate greater efficiency. All new homes in the UK are required to have a SAP rating to comply with the Building Regulations. The Tables in this leaflet show the benefits that upgrading a home's heating system can have on its SAP rating.

CARBON INDEX (CI)

The CI is based on the carbon emissions that are calculated as part of the SAP procedure, and is also explained in Ref[6]. The CI is expressed on a scale of 0.1-10.0 where 0.1 is poor (higher carbon dioxide emissions) and 10 is good. The Tables show how the CHeSS specifications can reduce carbon emissions and improve a home's CI.

ENERGY

The energy in kWh per year for the reference case, and percentage savings for CHeSS basic and best practice, are for heating and hot water energy consumption. The percentage saving is compared with the reference case, described below.

The percentage saving also applies to heating and hot water fuel costs (excluding standing charges), and CO_2 emissions.

Cost savings were calculated using energy prices taken from Table 12 of SAP 2001 (see Ref[6]). Actual costs may differ from this depending on fuel price changes and energy supplier.

THE REFERENCE CASE

Savings are based on comparisons with dwelling characteristics known as the reference case, which have been calculated using the BRE Domestic Energy Model (BREDEM). To get realistic savings, the reference case has heating systems and insulation standards typical of the housing stock.

Each type of dwelling has the same insulation standard, which is:

- Uninsulated solid floor (U-value varying depending on dimensions)
- 150 mm loft insulation (0.25 W/m^{2}K)
- Solid walls (U-value 2.1 W/m^{2}K) or filled cavity walls (0.466 W/m^{2}K)
- Draught-proofed single glazing (4.7 W/m^{2}K)
- Solid wooden doors (3.0 W/m^{2}K)

The main features of the heating system are:

- gas boiler with SEDBUK efficiency 67% (69% is the stock average and 2% is deducted to represent the proportion of the stock lacking boiler interlock)
- or LPG boiler with SEDBUK efficiency 69%
- or oil boiler with SEDBUK efficiency 76%
- cylinder thermostat present (not applicable for combi boiler systems)
- primary pipe-work uninsulated (not applicable for combi boiler systems)
- cylinder insulated to the stock average level, equivalent to a 55 mm insulating jacket on a 120 litre cylinder (not applicable for combi boiler systems)
- room thermostat and programmer, but no TRVs

Savings are calculated by changing the heating systems to meet the 'basic' and 'best practice' CHeSS specifications, but leaving the insulation and other characteristics unchanged. It is assumed that each dwelling is heated to 21°C in the living area during the morning and evening on weekdays, and all day at weekends.

Total floor areas are typical for each of the dwelling types as shown below.

Dwelling Type	Floor area (m^2)
Flat *	61
Detached bungalow	67
Semi-det. bungalow	64
Mid-terraced	79
End terraced	79
Semi-detached	89
Detached	104

*Top floor flat with two external walls (a top floor flat has an energy consumption intermediate between a ground and mid-floor flat).

CENTRAL HEATING SYSTEM SPECIFICATIONS (YEAR 2002)

BASIC (2002)

Reference	**CHeSS – HR3 (2002)**
Description	Domestic wet central heating system with regular boiler and separate hot water store.
Boiler *(see notes 5 and 6)*	■ A regular boiler (not a combi) which has a SEDBUK efficiency of at least: – 78% if fuelled by natural gas (bands A to D) – 80% if fuelled by LPG (bands A to C, and some from band D) – 85% if fuelled by oil (bands A and B, and some from band C).
Hot water store	EITHER ■ Hot water cylinder, whose heat exchanger and insulation properties both meet or exceed (*see note 7*) those of the relevant British Standards (see Refs[7], [8]). OR ■ Thermal (primary) storage system, whose insulation properties meet or exceed those specified in Ref[9].
Controls *(see notes 10, 11 and 12)*	■ Full programmer. ■ Room thermostat. ■ Cylinder thermostat. ■ Boiler interlock (*see note 13*). ■ TRVs on all radiators, except in rooms with a room thermostat. ■ Automatic bypass valve *(see note 14)*.
Installation	*See notes 1, 2, 3 and 4.*

BASIC (2002)

Reference	**CHeSS – HC3 (2002)**
Description	Domestic wet central heating system with combi or CPSU boiler.
Boiler *(see notes 5 and 6)*	■ A combi or CPSU boiler which has a SEDBUK efficiency of at least: – 78% if fuelled by natural gas (bands A to D) – 80% if fuelled by LPG (bands A to C, and some from band D) – 82% if fuelled by oil (bands A to C).
Hot water store	None, unless included within boiler.
Controls *(see notes 10, 11 and 12)*	■ Time switch. ■ Room thermostat. ■ Boiler interlock (*see note 13*). ■ TRVs on all radiators, except in rooms with a room thermostat. ■ Automatic bypass valve *(see note 14)*.
Installation	*See notes 1, 2, 3 and 4.*

CENTRAL HEATING SYSTEM SPECIFICATIONS (YEAR 2002)

RECOMMENDED BEST PRACTICE (2002)

Reference	**CHeSS – HR4 (2002)**
Description	Domestic wet central heating system with regular boiler and separate hot water store.
Boiler *(see notes 5 and 6)*	■ A regular boiler (not a combi) which has a SEDBUK efficiency of at least: – 86% if fuelled by natural gas (bands A and B) – 88% if fuelled by LPG (band A and some from band B) – 89% if fuelled by oil (band A and some from band B). These levels of efficiency can only be achieved by condensing boilers.
Hot water store	EITHER ■ High-performance hot water cylinder (*see note 8*). OR ■ High-performance thermal (primary) storage system (*see note 9*).
Controls *(see notes 10, 11 and 12)*	■ Programmable room thermostat, with additional timing capability for hot water. ■ Cylinder thermostat. ■ Boiler interlock (*see note 13*). ■ TRVs on all radiators, except in rooms with a room thermostat. ■ Automatic bypass valve *(see note 14)*.
Installation	*See notes 1, 2, 3 and 4.*

RECOMMENDED BEST PRACTICE (2002)

Reference	**CHeSS – HC4 (2002)**
Description	Domestic wet central heating system with combi or CPSU boiler.
Boiler *(see notes 5 and 6)*	■ A combi or CPSU boiler which has a SEDBUK efficiency of at least: – 86% if fuelled by natural gas (bands A and B) – 88% if fuelled by LPG (band A and some from band B) – 86% if fuelled by oil (bands A and B). These levels of efficiency can only be achieved by condensing boilers.
Hot water store	None, unless included within boiler.
Controls *(see notes 10, 11 and 12)*	■ Programmable room thermostat. ■ Boiler interlock (*see note 13*). ■ TRVs on all radiators, except in rooms with a room thermostat. ■ Automatic bypass valve *(see note 14)*.
Installation	*See notes 1, 2, 3 and 4.*

NOTES

APPLICABLE TO CHESS HR3, HC3, HR4, HC4 (YEAR 2002)

1 **Other components:** The specifications list only the principal components of a heating system affecting energy efficiency. Other components will be required, such as radiators, circulator pumps (see Note 4), cisterns (feed and expansion tanks), and motorised valves. All components must be selected and sized correctly.

2 **Design and installation:** Heating systems should be designed and installed in accordance with relevant safety regulations, manufacturers' instructions, the Benchmark scheme (see Ref[10]), Building Regulations (see Refs[1], [2], [11]), and British Standards (see Refs[12], [13]). More detailed advice on domestic wet central heating systems is given in the government's Energy Efficiency Best Practice Programme Good Practice Guides (see Refs[3], [4]), and Ref[5]. In England and Wales commissioning and handover of information on operation and maintenance is now a requirement of Building Regulations Part L1 (see Ref[1]) and a suitable commissioning certificate is published as part of Benchmark (see Ref[10]). More detailed advice on compliance with Building Regulations Part L1 in England and Wales is given in Ref[14].

3 **Water treatment:** Three types of water treatment should be considered – (a) cleaning and flushing of the system before use; (b) corrosion inhibition, and (c) softening of the water supply to combi boilers for hot water service in hard water areas. In each case the recommendation of the boiler manufacturer must be followed as damage may be caused by unsuitable treatment. For both new and replacement systems, cleaning is essential and, if recommended in the boiler manufacturer's instructions, a suitable chemical cleaning agent can be used. When a boiler is replaced it is essential to drain and flush all old water from the system lest it contains a corrosion inhibitor unsuitable for the new boiler. Advice on the need for treatment is given in clauses 26 and 38 of BS 5449 (see Ref[12]), and on causes of problems and methods of treatment in BS 7593 (see Ref[15]).

4 **Circulator pump:** Advice on pump dimensioning is available from the BPMA (British Pump Manufacturers' Association) website at **www.bpma.org.uk** Pumps installed separately from the boiler (not supplied as part of the boiler unit) which have automatic speed control should not be used in heating systems with TRVs unless the design of the pump and system ensures that the minimum flow rate through the boiler (as specified by the boiler manufacturer) is certain to be maintained under all conditions.

5 **Boiler size and type:** The whole house boiler sizing method for houses and flats gives guidance on boiler size and is available on the website **www.boilers.org.uk**

A **regular boiler** does not have the capability to provide domestic hot water directly, though it may do so indirectly via a separate hot water store.

A **combination (combi) boiler** does have the capability to provide domestic hot water directly, and some models contain an internal hot water store.

A **combined primary storage unit (CPSU)** is a boiler with a burner that heats a thermal store directly.

Each of these may be either a condensing or non-condensing boiler, and condensing boilers are always more efficient. Condensing boilers are fitted with a drain to dispose of the liquid condensate.

For further definitions of boiler types see Appendix D of Ref[6].

6 **Boiler efficiency**: SEDBUK ('Seasonal Efficiency of Domestic Boilers in the UK') is the preferred measure of the seasonal efficiency of a boiler installed in typical domestic conditions in the UK, and is used in SAP assessments and the Building Regulations. The SEDBUK efficiency

NOTES

of most current and obsolete boilers can be found on the website **www.boilers.org.uk** Although SEDBUK is expressed as a percentage, an A to G scale of percentage bands has also been defined as below.

SEDBUK range	*Band*
90% and above	*A*
86%-90%	*B*
82%-86%	*C*
78%-82%	*D*
74%-78%	*E*
70%-74%	*F*
Below 70%	*G*

7 **Hot water cylinder (basic)**: Vented cylinders shall comply with BS 1566:2002 (see Ref[7]). Unvented cylinders shall either comply with BS 7206 (see Ref[8]) or be approved by the BBA or other equivalent body. All cylinders must be factory insulated such that the standing heat loss will not exceed 1.6 x (0.2 + 0.051 V $^{2/3}$) kWh per 24 hours, where V is the capacity in litres. This is equivalent to about 0.8 watt per litre for the popular 117 litre cylinder.

8 **Hot water cylinder (high performance)**: A high performance cylinder may be either vented or unvented. The manufacturer must confirm that the heat exchanger and insulation properties exceed the requirements of the relevant British Standards (see Refs[7], [8]) as follows:

(i) The standing heat loss must not exceed 1.28 x (0.2 + 0.051 $V^{2/3}$) kWh per 24 hours, where V is the capacity in litres. This is equivalent to about 0.64 watts per litre for the popular 117 litre cylinder.

(ii) For vented cylinders the re-heat time for a capacity of 117 litres and above as measured in BS 1566: 2002 shall not exceed 20 minutes. Cylinders below 117 litres shall have a proportionately lower re-heat time (eg, not more than 10 minutes for a 58.5 litre cylinder).

(iii) The re-heat performance of unvented cylinders should be tested and certified using the procedure in BS 7206 (see Ref[8]) by the BBA or other third party. With a 15 litres/minute primary flow rate, the re-heat time for cylinders of 120 litres and above shall not exceed 20 minutes. Cylinders below 120 litres shall have a proportionately lower re-heat time (eg, not more than 10 minutes for a 60 litre cylinder).

(iv) For unvented cylinders tested with a 20 litres/minute primary flow rate (as per the Water Research Centre Procedure), the re-heat time for cylinders of 120 litres and above shall not exceed 17.5 minutes. Cylinders below 120 litres shall have a proportionately lower re-heat time (eg, not more than 8.75 minutes for a 60 litre cylinder).

9 **Thermal store (high performance):** A high-performance thermal (primary) storage system must have insulation properties exceeding by at least 15% those given in the WMA Performance Specification for Thermal Stores (see Ref[9]), and comply with the Specification in other respects.

10 **Circuits and zones**: Systems with regular boilers must have separately controlled circuits to the hot water cylinder and radiators, and both circuits must have pumped circulation. Large properties must be divided into zones not exceeding 150 m^2 floor area, so that the operation of the heating in each zone can be timed and temperature controlled independently.

NOTES

11 Definitions of **heating controls** are given in Ref[4]. The most common are repeated below.

A **time switch** is an electrical switch operated by a clock to control either space heating or hot water, or both together but not independently.

A **full programmer** allows the time settings for space heating and hot water to be fully independent.

A **room thermostat** measures the air temperature within the building and switches the space heating on and off. A single target temperature may be set by the user.

A **programmable room thermostat** is a combined time switch and room thermostat which allows the user to set different periods with different target temperatures for space heating, usually in a daily or weekly cycle. Some models also allow time control of hot water, so can replace a full programmer.

A **cylinder thermostat** measures the temperature of the hot water cylinder and switches the water heating on and off.

A **TRV (thermostatic radiator valve)** has an air temperature sensor which is used to control the heat output from the radiator by adjusting water flow.

12 **Wireless controls** should be designed with a satisfactory level of immunity to blocking by other radio transmissions. Otherwise they may become unreliable, or cease to work, as nearby radio frequency bands become increasingly heavily used from year 2002 onwards. Products bearing the new 'Radiomark' symbol have been certified to meet this requirement concerning quality, fitness for purpose, and traceability (see website **www.radiomark.org**). For products not bearing the Radiomark, the manufacturer should confirm that the switching range (and preferably alignment range) do not include any frequencies below 430 MHz, and that in regard to ETSI EN 300 220-1 v1.3.1 (see Ref[16]) the receiver classification (clause 4.1.1) is either Class 1 or Class 2, and the device is marked in accordance with clause 4.3.4. Compliance with the essential requirements under article 3.2 of the EC Radio and Telecommunications Terminal Equipment Directive 1999/5/EC is not sufficient, as the directive is designed only to ensure that wireless products do not cause harmful interference to other transmissions.

13 **Boiler interlock** is not a physical device but an arrangement of the system controls (room thermostats, programmable room thermostats, cylinder thermostats, programmers and time switches) so as to ensure that the boiler does not fire when there is no demand for heat. In a system with a combi boiler it can be achieved by fitting a room thermostat. In a system with a regular boiler it can be achieved by correct wiring interconnection of the room thermostat, cylinder thermostat, and motorised valve(s). It may also be achieved by more advanced controls, such as a boiler energy manager. TRVs alone are not sufficient for boiler interlock.

14 An **automatic bypass valve** controls water flow in accordance with the water pressure across it, and is used to maintain a minimum flow rate through the boiler and to limit circulation pressure when alternative water paths are closed. A bypass circuit must be installed if the boiler manufacturer requires one, or specifies that a minimum flow rate has to be maintained while the boiler is firing. The installed bypass circuit must then include an automatic bypass valve (not a fixed-position valve).

TABLE 1 – DWELLINGS WITH GAS BOILERS

The benefits of domestic gas wet central heating systems that meet the CHeSS specifications.

Dwellings with regular gas boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	60	69	73	4.2	5.1	5.4	15,400	19%	27%	40	57
Detached bungalow	49	57	61	3.2	3.9	4.3	24,200	18%	26%	58	84
Semi-det. bungalow	52	61	65	3.5	4.3	4.7	20,900	18%	26%	51	74
Mid-terraced	62	72	76	4.4	5.3	5.7	18,700	20%	28%	51	71
End terraced	51	60	64	3.4	4.2	4.6	25,500	19%	27%	64	92
Semi-detached	50	58	63	3.3	4.1	4.4	28,600	18%	26%	71	101
Detached	42	51	55	2.6	3.3	3.7	38,800	18%	25%	92	133

Dwellings with regular gas boilers – filled cavity walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	73	83	87	5.4	6.4	6.8	10,500	23%	32%	33	44
Detached bungalow	65	75	79	4.7	5.5	5.9	15,200	20%	28%	42	58
Semi-det. bungalow	68	78	82	4.9	5.8	6.2	13,500	21%	29%	39	53
Mid-terraced	77	88	92	5.8	6.8	7.2	12,700	23%	31%	40	54
End terraced	72	82	86	5.3	6.2	6.6	14,800	23%	31%	45	61
Semi-detached	69	79	83	5.0	5.9	6.3	17,100	22%	30%	50	68
Detached	65	75	79	4.7	5.6	6.0	20,700	21%	28%	57	79

Dwellings with combination gas boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	62	70	74	4.4	5.2	5.5	14,400	16%	24%	30	46
Detached bungalow	51	58	62	3.3	4.0	4.4	23,100	15%	23%	47	72
Semi-det. bungalow	55	62	66	3.7	4.4	4.8	19,700	15%	23%	41	62
Mid-terraced	65	73	77	4.6	5.4	5.8	17,500	17%	25%	40	58
End terraced	53	61	65	3.5	4.3	4.6	24,400	16%	24%	54	79
Semi-detached	52	59	63	3.4	4.1	4.5	27,400	16%	24%	60	89
Detached	44	51	55	2.7	3.4	3.8	37,800	16%	24%	82	122

Dwellings with combination gas boilers – filled cavity walls

Dwelling type	SAP			Carbon index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	77	85	89	5.8	6.5	6.9	9,100	16%	24%	20	29
Detached bungalow	68	76	80	4.9	5.7	6.1	14,000	16%	23%	29	44
Semi-det. bungalow	71	80	84	5.2	6.0	6.4	12,200	16%	24%	26	39
Mid-terraced	81	90	94	6.1	7.0	7.3	11,300	17%	25%	26	38
End terraced	75	84	87	5.6	6.4	6.7	13,300	17%	25%	31	45
Semi-detached	72	80	84	5.3	6.1	6.4	15,600	17%	25%	36	52
Detached	68	75	81	4.9	5.6	6.1	19,300	17%	25%	44	64

Note: CHeSS Basic and CHeSS Best are defined on page 2, and the Reference case on page 3.

TABLE 2 – DWELLINGS WITH LPG BOILERS

The benefits of domestic LPG wet central heating systems that meet the CHeSS specifications.

Dwellings with regular LPG boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	26	34	38	3.4	4.2	4.6	14,900	19%	27%	84	119
Detached bungalow	15	22	26	2.3	3.1	3.5	23,500	17%	25%	121	175
Semi-det. bungalow	18	26	30	2.7	3.5	3.8	20,300	18%	26%	107	155
Mid-terraced	28	37	41	3.6	4.4	4.8	18,100	20%	28%	108	150
End terraced	17	25	29	2.5	3.3	3.7	24,800	18%	26%	135	192
Semi-detached	16	24	28	2.4	3.2	3.6	27,700	18%	26%	149	213
Detached	9	17	21	1.7	2.5	2.9	37,700	17%	25%	192	278

Dwellings with regular LPG boilers – filled cavity walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	38	47	51	4.6	5.5	5.9	10,200	23%	31%	69	94
Detached bungalow	30	39	43	3.8	4.7	5.1	14,800	20%	28%	87	122
Semi-det. bungalow	33	42	46	4.1	5.0	5.4	13,100	21%	29%	81	112
Mid-terraced	42	52	56	5.0	5.9	6.3	12,400	23%	31%	84	113
End terraced	37	46	50	4.4	5.4	5.8	14,400	22%	30%	95	128
Semi-detached	34	44	48	4.2	5.1	5.5	16,600	21%	29%	105	143
Detached	31	41	44	3.8	4.7	5.1	20,100	20%	28%	120	166

Dwellings with combination LPG boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	28	35	39	3.6	4.3	4.7	14,000	15%	23%	64	95
Detached bungalow	16	23	27	2.5	3.2	3.5	22,500	15%	23%	98	150
Semi-det. bungalow	20	27	31	2.9	3.6	3.9	19,200	15%	23%	85	129
Mid-terraced	30	38	42	3.8	4.6	4.9	16,900	17%	24%	83	121
End terraced	19	26	30	2.7	3.4	3.8	23,700	16%	24%	113	166
Semi-detached	18	25	29	2.6	3.3	3.6	26,600	16%	24%	126	187
Detached	10	17	21	1.9	2.5	2.9	36,700	16%	23%	171	254

Dwellings with combination LPG boilers – filled cavity walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	42	49	53	4.9	5.7	6.0	8,800	16%	23%	41	61
Detached bungalow	33	41	45	4.1	4.9	5.2	13,500	15%	23%	61	92
Semi-det. bungalow	36	44	48	4.4	5.2	5.5	11,800	15%	23%	54	81
Mid-terraced	46	54	58	5.3	6.1	6.5	10,900	17%	25%	54	80
End terraced	40	48	52	4.7	5.5	5.9	12,900	17%	24%	64	93
Semi-detached	37	45	49	4.4	5.2	5.6	15,100	17%	24%	75	109
Detached	34	40	46	4.1	4.7	5.2	18,700	17%	24%	93	135

Note: CHeSS Basic and CHeSS Best are defined on page 2, and the Reference case on page 3.

TABLE 3 – DWELLINGS WITH OIL BOILERS

The benefits of domestic oil wet central heating systems that meet the CHeSS specifications.

Dwellings with regular oil boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	61	69	72	3.4	4.1	4.3	13,600	16%	20%	36	45
Detached bungalow	49	56	58	2.3	3.0	3.1	21,300	14%	19%	50	65
Semi-det. bungalow	53	60	63	2.7	3.3	3.5	18,400	15%	19%	45	58
Mid-terraced	63	72	74	3.6	4.3	4.5	16,500	17%	21%	46	58
End terraced	51	58	61	2.6	3.2	3.4	22,500	15%	20%	57	72
Semi-detached	49	57	59	2.5	3.1	3.3	25,200	15%	19%	62	79
Detached	41	48	50	1.8	2.4	2.5	34,200	14%	18%	79	102

Dwellings with regular oil boilers – filled cavity walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	76	85	88	4.6	5.4	5.6	9,200	20%	25%	30	38
Detached bungalow	66	75	78	3.8	4.6	4.8	13,400	17%	21%	37	47
Semi-det. bungalow	70	79	81	4.1	4.9	5.1	11,900	18%	23%	35	44
Mid-terraced	79	90	92	5.0	5.8	6.0	11,200	20%	25%	37	45
End terraced	73	83	85	4.4	5.2	5.4	13,000	19%	24%	41	51
Semi-detached	70	79	81	4.2	5.0	5.2	15,000	19%	23%	45	56
Detached	66	75	77	3.9	4.6	4.8	18,200	17%	22%	51	64

Dwellings with combination oil boilers – solid walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	64	69	71	3.6	4.0	4.2	12,700	9%	13%	19	27
Detached bungalow	51	55	57	2.5	2.9	3.1	20,400	8%	13%	28	42
Semi-det. bungalow	55	60	62	2.9	3.3	3.5	17,400	9%	13%	24	36
Mid-terraced	66	71	74	3.8	4.3	4.5	15,400	10%	14%	26	36
End terraced	53	58	60	2.7	3.1	3.3	21,500	10%	14%	34	49
Semi-detached	51	56	58	2.6	3.0	3.2	24,200	10%	14%	39	55
Detached	43	47	49	1.9	2.3	2.5	33,300	9%	14%	51	74

Dwellings with combination oil boilers – filled cavity walls

Dwelling type	SAP			Carbon Index			Energy (kWh/y) and % saving of base			Cost saving (£/y)	
	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	Ref Case	CHeSS Basic	CHeSS Best	CHeSS Basic	CHeSS Best
Flat	80	86	88	4.9	5.4	5.6	8,000	10%	14%	12	18
Detached bungalow	69	75	77	4.1	4.6	4.8	12,300	9%	13%	18	27
Semi-det. bungalow	73	79	81	4.4	4.9	5.1	10,700	9%	13%	16	23
Mid-terraced	84	90	93	5.3	5.8	6.0	9,900	11%	15%	17	24
End terraced	77	83	85	4.7	5.2	5.4	11,700	11%	15%	20	28
Semi-detached	73	79	81	4.4	5.0	5.1	13,800	11%	15%	24	33
Detached	68	73	77	4.1	4.5	4.8	17,000	11%	15%	29	41

Note: CHeSS Basic and CHeSS Best are defined on page 2, and the Reference case on page 3.

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